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How to Control Weeds in Corn

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EVERY YEAR, year after year, you're confronted with the problem of weed control in corn. Weed control is a serious and ever-present problem in corn production. Tillage practices, herbicides, clean seed, crop rotation, etc.—all are important. But no single one of these methods is enough—a good weed-control program includes some combination of these methods. The combination for you will depend both upon yourself and your particular weed problem.

This article is a summary of results obtained from experimental studies on weed control in corn. These studies were made cooperatively by the Agricultural Engineering, Agronomy and Botany departments of the Iowa Agricultural Experiment Station, the Division of Farm Machinery of USDA's Bureau of Plant Industry, Soils and Agricultural Engineering, and the Soil Conservation Service, USDA.

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Tillage Methods

Tillage operations may be classified technically as primary tillage, secondary tillage and mechanical cultivations.

Primary tillage is the initial operation you use in preparing a seedbed—and your first step in weed control. Using conventional practices, plowing is the primary tillage method. We've made studies on plowing, listing, subsurface tilling and disking. These studies show that:

- Plowing gives better initial weed control than other methods but requires more labor and power.
- Contour listing is superior to plowing with respect to soil and water conservation and requires less labor and power. While initial weed control usually is not as effective as with plowing, weeds are easier to control by subsequent cultivations.
- Subsurface tillage retains the mulch cover of the previous crop on the surface and helps conserve soil and water. But labor and power requirements for subsurface tillage are greater than for listing although less than for plowing. Subsurface tillage isn't as effective as plowing or listing for controlling weeds.
- Disking requires less labor and power than any of these methods. But it does the poorest job of controlling weeds.
- In experiments, plowing consistently has given higher yields, with listing a close second. Disking and subsurface tillage produce yields that are erratic and usually lower than plowing or listing.

In some of our more recent tests, we've combined primary tillage methods with pre-emergence herbicide applications. Results show that weed control and yield were improved with all primary tillage methods. Where herbicides were used, subsurface tillage and disking showed proportionately greater improvements in yields than listing or plowing.

Secondary tillage is any tillage operation you perform between primary tillage and planting. In this operation you kill weeds, level off surface irregularities and firm the seedbed.

Our studies show that once-over with a tandem disk-harrow, followed by a spike-tooth harrow just before planting, gives best weed control under ordinary conditions. Any additional tillage is wasted effort unless adverse weather conditions are prevalent or there is serious weed infestation. Then additional tillage with the disk-harrow or duckfoot cultivator may be warranted.

Mechanical cultivation needs little explanation. Before herbi-

cides were used extensively to control weeds, studies were made on cultivating equipment in growing corn. Under ordinary conditions, when weeds are small, early cultivations with a weeder, rotary hoe or spike-tooth harrow control weeds as well as the sweep cultivator. The sweep cultivator gives better control under unusually wet or dry conditions.

Under some conditions such as an abundance of cornstalks, the spike-tooth harrow tends to gather trash and materially reduces the yield by reducing the stand.

Some of the recent investigations show that it may be possible in some instances to eliminate early mechanical cultivations entirely by using pre-emergence applications of 2,4-D. Sweeps and disk hillers give best weed control when used for late cultivations. If susceptible broadleaf weeds are your main problem, late cultivations may be aided by a post-emergence herbicide application.

Herbicides

Use of chemicals to control weeds in corn is an important feature of any over-all weed-control program. Studies on the use of herbicides to control weeds in corn have been carried on for the past several years. The most reliable and most used chemical for controlling weeds in corn is 2,4-D.

Pre-emergence: Control of weeds in corn has been most effective by applying 1½ to 2 pounds per acre of 2,4-D acid equivalent in 5 to 10 gallons of water. We've obtained good results with both the amine and the ester forms. Esters are safer to use in corn—they leach less rapidly and are less likely to damage the crop.

Pre-emergence applications are generally made at or soon after planting. There's some indication that these applications can be made 1 or 2 days after the corn emerges, but this method needs further study and is not recommended now.

Inhibiting germination and growth of annual weeds so that the first cultivation can be delayed is the primary purpose of pre-emergence applications. This gives more leeway in the time of cultivation, makes wet weather less troublesome and gives excellent weed control with two mechanical cultivations rather than the customary three.

However, a pre-emergence application of 2,4-D isn't foolproof. Under some conditions, its likely to damage the crop and it may not control weeds. Keep these points in mind:

1—Use of 2,4-D as a pre-emergence spray on light, sandy soils may be dangerous. The chemical leaches more rapidly in these soils and can cause serious crop damage. Even reduced dosages of 1 pound per acre should be used cautiously.

2—Sodium salts and amines of 2,4-D leach more rapidly than esters and, therefore, are more dangerous.

3—Extremely cloddy soil surfaces result in poor weed control. A relatively smooth soil surface is needed to obtain best results from pre-emergence sprays.

4—To get maximum effectiveness from a pre-emergence application, the soil surface shouldn't be disturbed for 2 or 3 weeks following treatment.

How it works: Most annual weeds grow from seeds which germinate in the top inch of soil. Corn is planted deeper. Any 2,4-D applied to the soil surface is leached into the top layer by rains. The 2,4-D inhibits germination of weed seeds in the top inch or so of the soil and also injures the young weed seedlings.

Corn seed germinates below this layer of 2,4-D and usually is not materially injured as it emerges through the treated layer. Also the larger corn seed is "more robust" and more resistant to 2,4-D damage during germination than small weed seeds. By the time the roots of the corn plant are growing near the surface, the effect of 2,4-D has been greatly dissipated, and the corn plant is large enough to withstand some injury. Pre-emergence spray treatments with 2,4-D give control of annual grasses, which

WITHOUT PRE-EMERGENCE

The field above received three normal cultivations but no pre-emergence treatments. Note the abundant growth of weeds in the corn row.

WITH PRE-EMERGENCE

Shown above is corn alongside that had been given a pre-emergence treatment of 2,4-D in addition to the two regular cultivations.

are resistant to post-emergence or foliage sprays of 2,4-D.

Post-emergence: Foliage or post-emergence spraying is used mostly to control susceptible broadleaf weeds. We've obtained best results using ½ pound of acid equivalent per acre of the sodium or amine salt or ¼ pound of ester. Applying the 2,4-D in 10 to 15 gallons of water has been most satisfactory. To control late weeds such as cockleburs and buttonweeds, you'll need a high-clearance machine or an airplane.

Here are the precautions to remember in applying post-emergence sprays:

1—Never overdose; use only enough to kill the weeds.

2—Avoid spraying on extremely warm and humid days when corn is growing rapidly.

3—keep as much spray as possible away from the corn plants, but get good coverage of weeds.

4—Do not cultivate after spraying for at least 7 to 10 days.

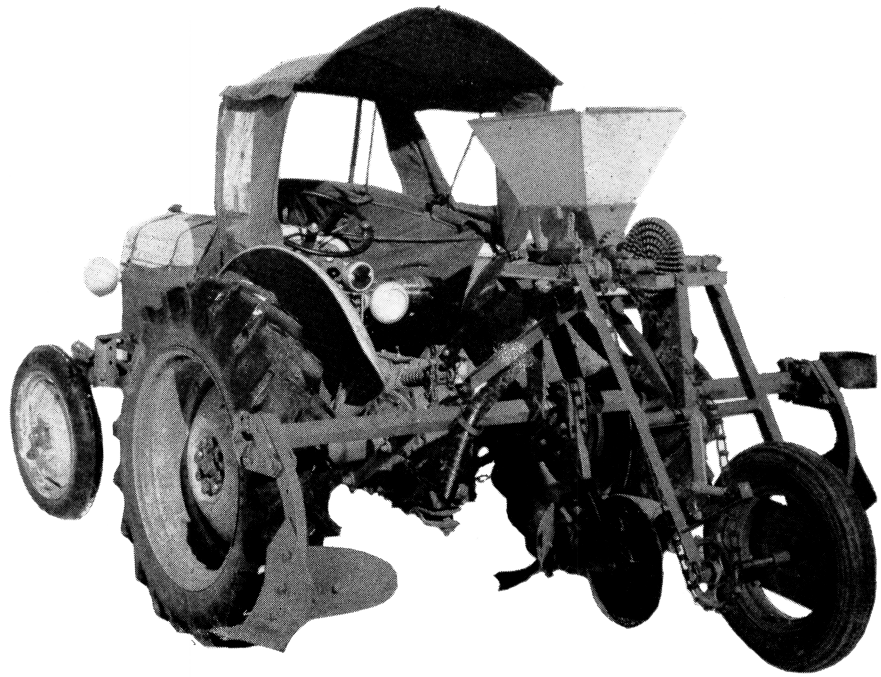
5—Avoid spraying on windy days to prevent drift; use pressures of 25 to 35 pounds.

For additional information on herbicide applications, refer to Iowa Agricultural Extension Service Pamphlet 140 (revised).

Equipment: Selecting proper equipment for applying weed sprays depends upon you and what you expect to do.

Farm spray equipment may be used for spraying weeds in row crops, small grains, pastures and weeds along roadsides or other areas. It may also be used for controlling corn borers or other insect pests—or used for spraying livestock. The adjustments needed to accomplish all of these jobs should be considered in selecting your equipment. Additional information on selecting spraying equipment may be found in Iowa Agricultural Extension Service Pamphlet 152.

Sprayers, like all forms of mechanical equipment, need care and maintenance. This should be fitted to the particular sprayer and include (1) a summer operational-maintenance program and (2) a winter storage program.



This is an experimental machine built to make pairs of ridges giving an opportunity to test ridge planting in studies. It's also equipped to obtain deep placement of nitrogen fertilizer. This machine makes the desired types of ridges—spaced uniformly to fit the planter.

Included in the summer program should be operating precautions to prevent breakdowns, lubrication of pumps and of other moving parts, protection against weather, thorough flushing between periods of operation and between chemicals, and thorough cleaning of nozzle tips and strainers at the time of flushing.

Care of spraying equipment during winter months is important for efficient performance and long life of the machine. Allowing spray solutions or water to freeze and thaw in a sprayer causes heavy rust formations in the tank and can ruin pumps, pressure gauges, pressure regulators and hoses.

Before winter storage, sprayers should be drained and completely dried out and precautions taken to prevent rusting. Pumps, pressure gauges and regulators, and hoses should be removed. Clean these parts thoroughly, check them for wear and store them under conditions which will prevent rusting. If you use oil or grease to prevent rust on metal parts of the sprayer, take the rubber hoses off and do a thorough job of cleaning before you put them back.

When getting the sprayer ready for operation, a good job of cleaning, adjusting loose connections and replacing worn parts may save many hours of time in the field. You can do a better job of spraying with a machine that works properly.

One method of removing rust from the inside of a spray boom is to use a stranded wire cable. Flare about 2 inches of one end of the cable and weld the other end to fit the chuck of an electric drill. Pulling the cable through the boom while the drill motor is running causes a wire brush action that does a good job of cleaning. Use caution to avoid excessive whipping of the cable as you withdraw it from the boom. But it's better to prevent rust than to have to clean the boom after rusting has taken place.

Flame Weeding

In general our results from flame weeding haven't been successful because of (1) the high cost of the equipment and materials and (2) the damage that may occur when flame weeding is practiced.

Experiments show that flaming can be done without cutting yield if it's done before the corn is 2 inches high or after it is more than 1 foot high. Most broadleaf weeds are killed by flaming, but perennial grasses recover and continue to grow even after repeated flamings. We

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do not recommend flame weeding at this time.

Preventing Seed Formation

Preventing weed seed from forming is effective in weed control. But usually it's more costly than the methods already discussed. Preventing weeds from producing seed through good farming methods must be done constantly for several years in succession before worthwhile results are accomplished.

Summer fallowing is effective in controlling hardy perennial weeds that can't be controlled by other methods. But it must be done regularly and thoroughly, and no crop is produced during the process.

Plowing is an effective emergency measure to prevent weeds from producing seeds. Mowing or cutting is effective and is used extensively in some areas. Smother crops, too, are of value in controlling heavy noxious weed infestations. All of these practices are expensive, but they play a part in the over-all weed-control program which is essential to good farming.

Weed-Free Seed

Use of certified weed-free seed is one of the basic steps in preventing weed seed distribution. Be sure that your seed is thoroughly cleaned, tested and treated before seeding. Another essential is to thoroughly clean combines, threshing machines, corn pickers and other seed-handling equipment.

Use care in selecting weed-free hay to prevent distributing weed seeds with manure. Avoid cleanings, "chicken scratchings" and packing materials infested with weed seed.

Ridge Planting

One of our current investigations in primary tillage is "ridge planting"—something like listing, but planting seed on the ridges rather than in the furrow. Ridge planting requires pairs of ridges with uniform cross-section to facilitate planting and cultivating. An ordinary lister makes pairs of furrows, and the resulting ridges don't have a uniform cross-section. A machine has been developed, however, to make pairs of ridges rather than pairs of furrows.

Our past studies have shown listing to be one of the most promising methods of primary tillage. The main drawback to listing is the reduction in stands caused by (1) flooding, (2) early mechanical cultivations and (3) planting in the relatively cold subsoil. Ridge planting should eliminate two of these drawbacks but would make early mechanical cultivations even more difficult. However, the possibility of eliminating early cultivations by using herbicides gives this tillage method a great deal of promise.

How it would work: The proposed plan is to maintain these ridges—that are laid out with a slight grade—throughout the entire rotation. Between the first- and second-year corn, the ridges would be split, so that the furrows would be where the ridges were the previous year. This would give excellent coverage of stalks. Maintaining these ridges year-around makes this tillage method superior to all others in conserving soil and water. And it *may* eventually come to be used in place of strip cropping and small terraces.

Laying out the ridges to the proper grade to avoid getting many point rows and wasted land is a problem. But competent agricultural engineers can do the job, and the expense may be justified by the fact that it need be done only once.

Preliminary results: Preliminary field trials with this primary tillage method, combined with a pre-emergence application of 2,4-D, showed outstanding results insofar as weed control was concerned. This past season, field trials were made both on slopes and on flat land.

Corn planted on slopes received two mechanical cultivations—one when corn was 15 to 18 inches high, another when 24 to 30 inches high. One field remained practically weed-free throughout the entire season. Because of adverse weather conditions, most of the surrounding areas were heavily infested with weeds.

On level land, record-breaking amounts of rainfall throughout the growing season caused flooding and ponding of the experimental area. But ridge-planted plots were able to withstand more flooding than any of the other methods. There were whole plots of ridge planting with good stands and yields in the middle of ponded areas where half to three-quarters of plots on either side were flooded out. This indicates considerable possibility for using this method on low, flat land where flooding or standing water is a problem.

Not new: Ridge planting isn't new; it has been used successfully in some parts of the country for many years. But the difficulties encountered in trying to control early weeds with mechanical cultivation have helped prevent its adoption in this area.

The possibility of controlling these weeds and eliminating the need for early cultivations through pre-emergence spraying has made this a promising method of primary tillage. Mechanical cultivations can be done efficiently with sweeps and large disk hillers after the corn or other crop plants are large enough to withstand this type of cultivation.

However, this tillage method needs additional study. It is *not recommended* as a primary tillage method in this area at the present time.